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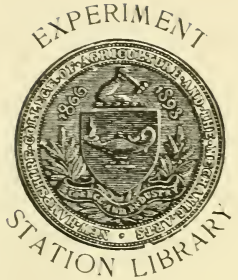

Class 639.73

Number N53

Volume 3 cop 2

Source Binding

Received July 1929

Cost

Accession No. 15435

Bulletin 114 November, 1904

NEW HAMPSHIRE COLLEGE
Agricultural Experiment Station

THE BABCOCK TEST

FOR

NEW HAMPSHIRE FARMERS

BY IVAN COMINGS WELD

NEW HAMPSHIRE COLLEGE
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AGRICULTURE AND THE MECHANIC ARTS
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THE BABCOCK TEST FOR NEW HAMPSHIRE FARMERS

BY IVAN COMINGS WELD

For the most successful management of the dairy herd the Babcock test is a necessity. To gain the highest degree of success, owners of dairy cattle must know the productive capacity of each individual cow in the herd.

But few farmers realize the difference in cows in this particular. To show that a difference exists among individual cows, and also that the per cent. of fat in milk from the same cow varies greatly at different times a herd of eight cows was tested morning and night for a period of three days.

The results are here given:

Cows.	Morning.	Night.	Morning.	Night.	Morning.	Night.	Average.
1	5.80	5.30	6.50	5.40	6.80	5.10	5.81
2	2.80	3.00	4.00	3.50	3.70	3.80	3.46
3	6.00	5.10	5.30	5.90	5.90	6.00	5.70
4	3.00	3.00	4.50	3.50	3.10	2.90	3.33
5	4.40	3.90	6.40	4 20	5.90	5.30	5.01
6	3.90	3.50	3.00	3.30	4.30	4.20	3.70
7	3.40	3.50	3.50	2.70	2.90	3.00	3.16
8	6.00	6.50	6.10	6.50	6.30	7.20	6.43

These figures should be sufficient to show the wide differences between individual cows in the production of butter fat. They also emphasize the necessity of taking for the test a composite sample from the entire milking, both morning and night, for a period of three or more days.

From the above table it will be seen that the average per cent. of fat in the milk produced by cow No. 7 was 3.16, while cow No. 8 tested 6.43. In other words, if each cow

produced an equal amount of milk during this period, cow No. 8 produced more than twice as much butter fat as cow No. 7. Since fat is worth from 20 to 30 cents a pound, we see the value of the Babcock test in enabling the farmer to weed out the unproductive cows.

The variations in the per cent. of fat in milk from the same cow are also shown to be large.

COMPOSITION OF MILK

Forty-seven quarts of average cows' milk will weigh 100 pounds, of which 87 pounds is water, 3.8 pounds fat, 3.4 pounds casein and albumin, 5 pounds sugar, and .8 pounds ash.

Fig. 1.

Fig. 2.

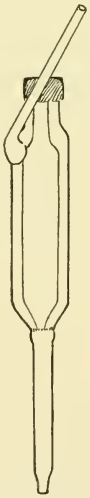

Fig. 3.

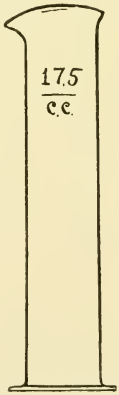

Fig. 4.

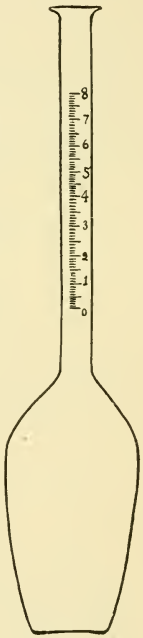

Fig. 5.

THE TESTING OUTFIT

The smaller sizes of the Babcock testers are well adapted for use on the farm. The test is simple and can be made by any bright boy or girl after a reasonable amount of practice.

The outfit consists of a pipette (Fig. 1) for measuring the milk sample. (Figures 2 and 3 show undesirable forms of pipettes.) A small jar (Fig. 4) for measuring the acid, and

Fig. 6.

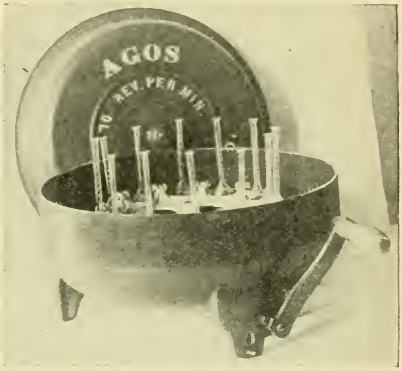

Fig. 7.

a special bottle or test tube with graduated neck, illustrated in Fig. 5, and a machine (Figs. 6 and 7) so constructed that the bottles and contents can be enclosed and whirled at a high speed.

TAKING THE SAMPLE

The pipette is graduated to hold exactly 17.6 cubic centimeters of milk, and when well drained will deliver 17.5 cubic centimeters in the test bottle. No test of any kind can be of value unless one first obtains a perfectly fair sample. Under some circumstances it may be difficult to get a fair sample of milk. On the farm, however, there need be no difficulty, but if one has some knowledge regarding the nature of milk, success will be more certain. Butter fat is found in milk in small particles, or globules (Fig. 8). These globules are so small that they can be seen only by the aid of a powerful microscope. The first milk drawn from the udder of a cow contains comparatively few fatty globules, while that milk which is obtained by "stripping" is exceedingly rich in fat. It will be seen that a fair and accurate sample for testing can be obtained only after the milk has been completely removed

from the udder and subjected to a thorough mixing. This can best be done by pouring the milk from one pail to another, and repeating the action several times. The milk will now be in a condition to sample, and this is best done with a small dipper, removing enough to cover the bottom of a pint jar three fourths of an inch deep. Five or six drops of formaline must be added to the milk to prevent souring, and the jar plainly labeled with the name of the cow. After the next milking another three fourths of an inch of milk should be added to the sample in the jar and the whole thoroughly mixed. This process should be repeated morning and night for at least three days.

Jersey Whole Milk × 500.

Fig. 8.

The composite sample thus obtained should be thoroughly mixed by pouring from one vessel to another so that the fatty globules may be evenly distributed. The small end of the pipette is placed in the milk, and with the mouth applied at the other end draw the pipette nearly full. The end of the forefinger should be quickly placed over the top end of the pipette as it is removed from the mouth, and holding the pipette on a level with the eye allow the milk to slowly settle until its surface is even with the 17.6 mark. With the test tube in the other hand (Fig. 9) insert the point of the pipette far enough to allow the milk to run into the tube without spill

ing. After the pipette has drained for a minute carefully blow the last drop from it, and the sample will be ready for the acid.

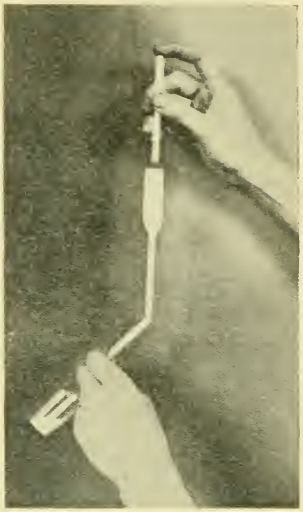

Fig. 9.

ADDING THE ACID

Sulphuric acid is a deadly poison. It will also destroy clothing, and char wood and other substances with which it comes in contact. Its use in testing milk seems quite necessary, however, and there need be no trouble resulting from its use if one realizes at the start that it must be handled with the utmost care. The common commercial acid is used in testing, and it should have a specific gravity of 1.82 or 1.83. It should be used at a temperature ranging from 50 to 70 degrees Fahrenheit, kept in a tightly stoppered bottle plainly labeled "Poison," and put in a place beyond the reach of children. Care must be taken in mixing acid with milk; 17.5 cubic centimeters are measured in the small jar (Fig. 4), or with the safer automatic acid measure (Fig. 10) which should form a aprt of the testing outfit, and this amount of acid is then slowly turned into the test tube. The acid should be allowed to run down on the side of the bottle so as to wash down any particles of milk and at the same time avoid burning the milk solids, which will usually take place when the acid is poured directly into the milk.

Fig. 10.

The acid should now appear in a separate layer under the milk, and holding the bottle by the neck a complete mixture can be effected by giving

it a gentle rotary motion. The mouth of the bottle must never be covered while mixing. The action of the acid on the water of the milk causes a rapid change in temperature, heating the mixture to a high degree and at the same time dissolving all the non-fatty solids of the milk and making possible a rapid and complete separation of the fats.

WHIRLING THE BOTTLES

The test bottle and contents should now be placed in a special machine and whirled at a high speed. The bottles assume a horizontal position as the machine reaches the required speed, and as the fats are the lightest part of the milk, they will gather in a layer on the surface of the liquid nearest the center of the machine. Although the principle is the same in all machines used for whirling bottles, there are several types and sizes adapted for different requirements. The power machines (Figures 11 and 12) are usually used in creameries and wherever steam is available.

The required speed of the machine will necessarily depend upon the diameter of the revolving bottle carrier.[1] For the power machines a speed indicator is necessary, but the operator of the hand machine can note the number of revolutions of the bottle carrier to one revolution of the crank and govern his speed accordingly. With the hand machine full speed should be maintained for seven minutes for the first whirling, after which the bottles should be placed in boiling water to keep the contents hot, and enough hot water should be added to the contents of the bottle to bring the liquid to the base of the neck, or even up to the zero mark. The bottles are now replaced in the machine and whirled again at full speed for three minutes. The fats will collect at the base of the neck during the second whirling, and after the machine is at a standstill enough hot water should be added to float the fat within the limits of the graduated scale on the neck of the test bottle. The bottles are again whirled for two minutes at full speed, after which they should be placed in a basin of water hot

[1] A bottle carrier fifteen inches in diameter should be made to revolve 1,000 times per minute.

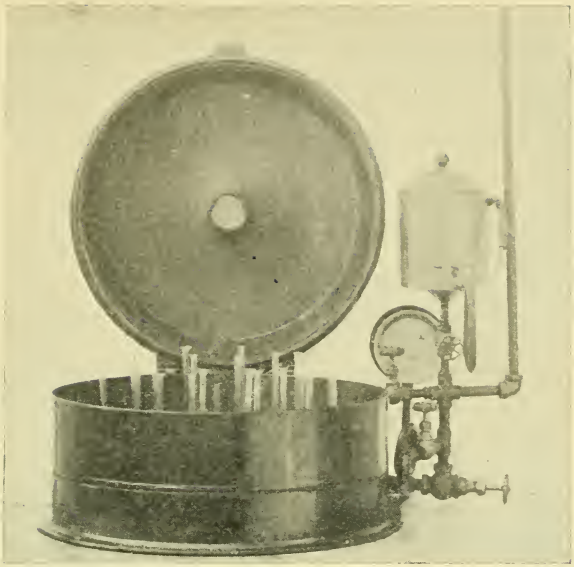

Fig. 11.

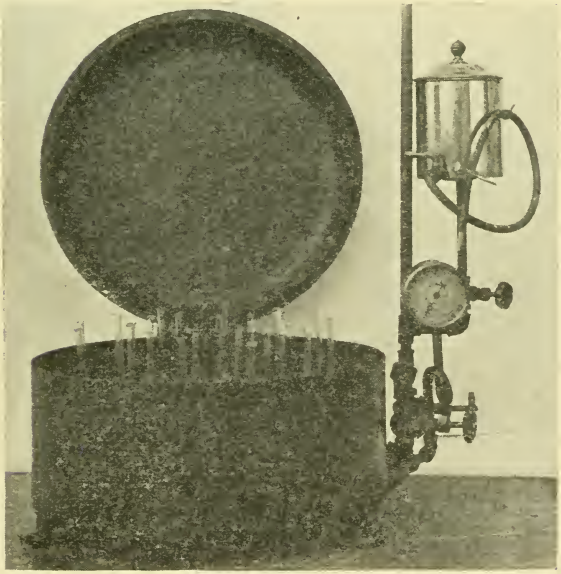

Fig. 12.

enough (125 to 140 degrees) to keep the fat in a clear liquid state in which condition the reading or measurement of the fat column should be made. If a steam power machine is used it will not be necessary to remove the bottles to the hot water.

READING RESULTS

The reading of the per cent. of fat is made direct from the graduated scale on the test tube. Bottles for whole milk are usually graduated to allow readings as high as eight or ten per cent. A pair of dividers, or small compasses (Fig. 13) can

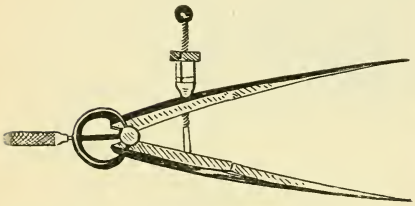

Fig. 13.

Fig. 14.

be used to good advantage in reading the results. The two points are carefully adjusted so that they exactly enclose the fatty column. (Fig. 14.) The lower point is then placed at the zero mark, leaving the other point on what will be the exact reading.

CREAM TESTING

In cream testing similar methods are employed except that special cream bottles (Fig. 15) graduated to measure from twenty-five to fifty per cent. of fat are used, and the cream samples must be taken by weight instead of by measure. Fig. 16 shows a desirable cream scale used for this purpose. The reason for weighing is found in the fact that a given volume

of cream is lighter in weight than the same volume of milk, also because the necessary mixing of the cream is apt to cause a mixture of air with the liquid, increasing its bulk, and because more or less cream is sure to adhere to the pipette, rendering any form of measurement inaccurate. The figures in the following table give the average result of a large number of tests and show the approximate discrepancy when cream is sampled by the use of an 18 cc. pipette, and illustrates the injustice resulting from its use:

Fig. 15.

Sampled with pipette (18 cc.).

Sample No. 1.....22.00 per cent. fat.
Sample No. 2.....24.00 per cent. fat.
Sample No. 3.....29.50 per cent. fat.
Sample No. 4.....31.00 per cent. fat.
Sample No. 5.....38.50 per cent. fat.

Sampled by weight 18 grams.

Sample No. 1.....22.00 per cent. fat.
Sample No. 2.... ...24.25 per cent. fat.
Sample No. 3... ....30.35 per cent. fat.
Sample No. 4.....32.00 per cent. fat.
Sample No. 5.....40.00 per cent. fat.

It will be seen that in sample No. 5 there is a difference of one and one half per cent. between the pipette and the scale, or one and one half pounds of butter fat for every hundred pounds of cream. Dealers in cream should use the scale in sampling cream for testing, and farmers selling cream should insist on this method. If necessary a state law should compel its use.

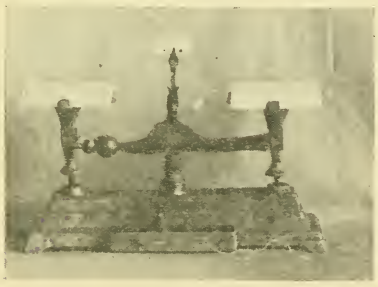

Fig. 16.

SKIM MILK—BUTTER MILK

Skim milk and butter milk are sampled and tested same as whole milk. Samples of skim milk should not be taken direct from the separator as it may then contain small air bubbles. A special test tube (Fig. 17) has been devised for this work.

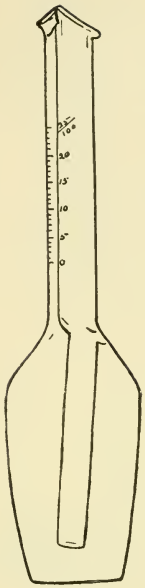

Fig. 17.

The neck of the tube contains two openings. The milk and acid are poured through the larger. The smaller tube is graduated for measuring the fat. The latest improved bottle is graduated from zero to twenty-five hundredths of one per cent., each division representing one one-hundredth of one per cent.

CLEANING GLASSWARE

Accurate results can only be obtained when clean glassware is used, and one of the most common faults among users of the test is the failure to keep the glassware clean and bright. Injustice often results through neglect in this matter. If the pipette is not thoroughly cleaned a coating will form inside sufficient to reduce the capacity of the pipette, thereby making the sample too small, and possibly defrauding a creamery patron of several dollars. If the point of the pipette has accidentally or otherwise been broken, the capacity will also be reduced, and produce results similar or worse than those resulting from an unclean instrument.

When bottles are not properly cleaned a coating will form inside the neck and the resulting lessened capacity will cause the fatty column to occupy a greater part of the graduated neck than it should. The result will, in this case, be unjust to the creamery, as the per cent. of fat will appear larger than it actually is. The evil of unclean glassware is not only the evil of uncleanliness, but it may also seriously affect results.

There need be no trouble in keeping glassware bright if it is cleaned as soon as used. Immediately after finishing with the pipette, rinse with cold water, then fill with soap and hot water and shake thoroughly, after which rinse with clean hot water.

In cleaning test bottles pour out the milk and acid as soon as the per cent. of fat has been determined and shake thoroughly while emptying, so that the sediment on the bottom of the bottle may be completely removed. Next prepare a

strong solution of soap powder and hot water and fill the bottle one third full, allowing it to run down on all sides of the glass. Shake thoroughly, drain and rinse with boiling hot water; drain dry and put away where no dust or flies will gain entrance.

NEW HAMPSHIRE LAW REGARDING THE USE OF MILK TESTS.

AN ACT FOR THE PRODUCTION AND SALE OF PURE MILK IN THE MARKETS OF THE STATE.

Be it enacted by the senate and house of representatives in general court convened:

SECTION 1. Every person who holds or fills the position of milk inspector in any city or town in this state, or who, either for himself or in the employ of any other person, firm, or corporation manipulates the Babcock test, or any other test, whether mechanical or chemical, for the purpose of measuring the contents of butter fat or solids in milk or cream as a basis for apportioning the value of such milk or cream, or the butter or cheese made from the same, shall procure from the superintendent of the dairy department of the New Hampshire College of Agriculture and the Mechanic Arts a certificate showing that the holder is competent and well qualified to perform such work. The fee for issuing such certificate shall in no case exceed one dollar, the same to be paid by the applicant to said superintendent, and to be used by the superintendent in meeting the expense incurred by him under this section.

SECT. 2. Every instrument or piece of glassware used for testing or measuring milk or cream at any creamery, butter factory, cheese factory, or condensed milk factory in determining the value of milk or cream received from different persons, or by milk inspectors in any city or town in this state, shall be tested for accuracy of measurement and for the accuracy of the per cent. scale marked thereon by the superintendent previously named or by some competent person designated by him. The superintendent or some person thus designated shall so mark such instruments or glassware with such marks or characters as cannot be erased, which marks or characters shall stand as proof that they have been so tested; and no incorrect instruments or glassware shall be thus marked. The superintendent of the dairy school shall receive for such service the actual cost incurred and no more, the same to be paid by the person or corporation for whom the test is made.

SECT. 3. The person or persons who grant certificates and test appliances at the New Hampshire College of Agriculture and the Mechanic Arts shall keep a record of all persons to whom certificates are issued with the dates thereof, and of the number and description

of all instruments and pieces of glassware inspected and marked, and for whom each article or lot was inspected and marked.

SECT. 4. Any person who tests milk or cream by the Babcock test, or any other test, whether mechanical or chemical, for the purpose of measuring the contents of butter fats or solids when sold as milk or as a basis for apportioning its value when used at creameries or factories, without first having obtained a certificate of competency in the manner previously named in this act, or who tests milk or cream to determine or apportion its value with appliances that have not been inspected and marked by the authorities herein named, shall be liable to a fine of not less than five dollars for each week that he or she serves or that such unmarked and untested appliances have been used.

SECT. 5. This act shall take effect July 1, 1901.

[Approved, March 22, 1901.]

IN CONCLUSION

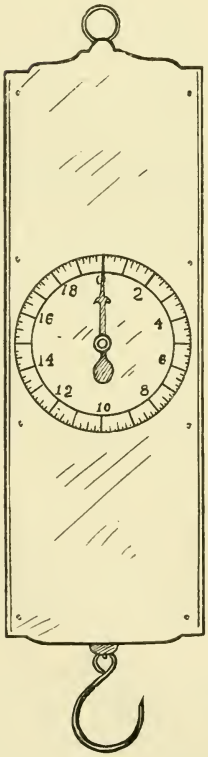

Fig. 18.

1. The Babcock test should be used on every farm where cows are kept.

2. The milk of each cow should be weighed and recorded morning and night.

3. At least one composite sample of milk should be taken and tested every month the cow is in milk. Skim milk and butter milk should be tested frequently.

4. The Babcock test and scales for weighing milk (Fig. 18) enable a farmer to place the management of his herd on a business basis. It reduces the business to a system. Lack of system drives the boys from the farm.

5. The station will gladly coöperate with any dairy farmer who desires further information regarding the test, and whenever six or more farmers in any locality in the state so desire the station stands ready to send a man to further discuss its merits and demonstrate, in a practical way, the benefits which will follow the introduction of the test system in the management of the dairy herd.

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